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Effect of Tri Sodium Citrate in the Treatment of Clinical Mastitis in Cattle

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ABSTRACT: A study was conducted in the department of Clinical Veterinary Medicine, College of Veterinary and Animal Sciences, Mannuthy, Kerala, to assess the efficacy of oral administration of tri-sodium citrate as therapeutic agent in clinical mastitis of cattle and to evaluate the levels of pH, citric acid, calcium, lactose and chloride in milk of cattle affected with mastitis. The pH and chloride levels of the affected quarter milk before the treatment showed significant increase compared to the unaffected quarter milk values. These values showed significant decrease to normal level on post treatment. The mean values of citric acid, lactose and calcium levels of the affected quarter milk before the treatment showed significant decrease compared to the unaffected quarter milk values. These values significantly increased and reached normal levels after treatment. Oral administration of tri-sodium citrate along with antibiotic was found to be effective in managing clinical mastitis cases. 100 percent bacteriological cure was observed in this group whereas only 75per cent bacteriological cure observed in the other group.

KEYWORDS: clinical mastitis, Trisodium citrate, Biochemical changes in milk

I. INTRODUCTION

Mastitis is the inflammation of the parenchyma of the mammary gland. It is a disease complex having different causes, different degrees of intensity and variation in duration and residual effects (Schalm and Woods, 1953). It is characterized by pathological changes in the glandular tissue followed by physical and biochemical changes in milk. For the efficient mastitis control early detection and treatment of the disease in the subclinical stage is important. Generally mastitis milk has been found to be alkaline and hypocitreamic (Dhillonet *al.*, 1989).The alkaline pH is very much favorable for the multiplication of bacteria (Cruickshank *et al.*, 1969). According to Dhillonet *al.* (1995) restoration of pH and other constituents of milk is also important for the clinical management of mastitis and oral administration of tri-sodium citrate is recommended as a therapeutic measure. With this background information, the study was conducted to detect the efficacy of oral administration of tri-sodium citrate as a therapeutic agent in the management of clinical mastitis of cattle.

II. REVIEW OF LITERATURE

Schalmet *al.* (1971) reported that normal cow milk had a range of pH from 6.4 to 6.8 with an average of about 6.6. The acidity of the milk was due to free acidic groups of casein, citrate and phosphate as well as to the presence of dissolved CO₂. In mastitis due to increased permeability, there was dilution of milk with more alkaline blood components principally bicarbonate, making milk alkaline. He also opined that impaired lactose production during mastitis was probably due to altered osmotic equilibrium induced due to more concentration of sodium chloride in the milk.Osmotic equilibrium was maintained with that of blood by a reduction in the secretion of lactose. And also observed that citrate was present in levels of about 150 mg/100 g milk. It functions as a chelating agent in milk, sequestering some 15 to 20 per cent of the calcium. It also imparts acidity to normal milk.

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The final stage of lactogenesis was preceded by the onset of citrate secretion into colostrum and citrate was essential for milk synthesis (Peaker and Linzell, 1975).

Dhillonet *et al.* (1989) reported that the normal milk pH was 6.5 which might be prohibitive for bacterial growth.

Dhillonet *et al.* (1995) reported that there was decrease in bacterial count and replenishment of milk citric acid after administration of 12 g of trisodium citrate in 250 ml of water orally till recovery from the mastitis. Milk pH was dropped to 6.5, which was unfavorable for bacterial growth.

Following oral treatment with 15 g of tri-sodium citrate in 250 ml water daily for six to eight days, milk consistency, pH and percentage of citrate, total proteins and lactose in mastitis milk in cows were restored to near normalcy (Singh *et al.*, 1997)

Triple therapy with trisodium citrate, ampicillin and gentamicin appeared to be the ideal therapy for subclinical mastitis in 80 buffaloes compared to triple drug therapy with trisodium citrate, tilox and streptopenicillin (Dicrysticin-S) or solitary administration of tri-sodium citrate (Reddy *et al.*, 1999).

Restoration of milk consistency, pH, percentage of total proteins, lactose, citrate and fat was found after treatment with 15 g of tri-sodium citrate in 250 ml water orally once daily till recovery in ten buffaloes suffering from mastitis (Dhillonet *et al.*, 2000).

Chloride content increased significantly from the normal value of 83.05 ± 8.73 mg per cent to 277.10 ± 1.67 mg per cent in clinical mastitis milk samples of cows (Charjanet *et al.*, 2001).

III. MATERIALS AND METHODS

Cows presented to the Veterinary College Hospital, Mannuthy, with the history of reduction in milk yield and clinical signs of mastitis were selected for treatment trials. The selected cases of mastitis affected cows were subjected to detailed clinical examination. Detailed clinical examination was carried out as per the procedure described by Boddie (1969). Also the udder was examined in detail for pathological changes in udder tissue and milk. Milk samples were collected from the affected and non affected quarters of all the cases for the estimation of pH, antibiotic sensitivity test, estimation of citric acid, calcium, lactose and chloride in milk on zero, third and sixth day of treatment. The clinical mastitis cases selected for therapeutic trials were divided into two groups. Suitable antibiotics were selected depending on the clinical signs and antibiotic sensitivity tests wherever possible.

Group 1 (seven animals) - Treated with Tri-sodium citrate @ 30 mg/kg body weight orally once daily for five days and antibiotic parenterally for three to five days.

Group 2 (eight animals) - Treated with antibiotic parenterally for three to five days.

Animals were allotted to each group randomly. Data were analysed as per the method described by Snedecor and Cochran (1994).

IV. RESULTS AND DISCUSSION

The mean values of pH and chloride of milk in cows affected with clinical mastitis were significantly high ($P \leq 0.01$) when compared to the mean values of normal of milk (Table 1 and 2). During the treatment the pH and chloride levels of the milk with clinical mastitis gradually reduced on third day which was treated with tri-sodium citrate along with antibiotic (group 1). And on sixth day of treatment the parameters in milk of the above groups of animals became normal and it was in agreement with the reports made by Reddy *et al.* (1999) and Dhillonet *et al.* (2000). Where as in animals treated with antibiotic alone, decrease in pH and chloride was not so appreciable when compared with group 1. The citric acid level in milk of cows having clinical mastitis before treatment were very low when compared to the milk of an affected quarter. During treatment the citric acid level in mastitis milk is gradually increased on third day which was treated with tri-sodium citrate along with antibiotic (group 1). And on sixth day of treatment the citric acid level in milk of group 1 animals became normal. But in animals treated with antibiotic alone (group 2), increase in citric acid was not so considerable when compared with group 1 (table 1 and 2). The acidity of milk is due to free acidic groups of casein, citrate and phosphate as well as to the presence of dissolved CO_2 (Schalmet *et al.*, 1971). A low level of citric acid was observed in mastitis milk. Extent of reduction in the level of citric acid may depend on the severity of

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inflammation. Citric acid deficiency causes retention of calcium in the secretory alveoli adversely affecting the alveoli by causing necrosis of the secretory epithelium and thereby leading to cessation of milk (Pal *et al.*, 1995). It was noted that the citric acid level increased drastically in group 1 from third day onwards which was treated with both oral tri-sodium citrate and antibiotic parenteral. Administration of tri-sodium citrate raised the citric acid level of the milk and was in agreement with the findings of Dhillonet *al.* (2000).

The mean lactose and calcium concentrations in the mastitis milk before the treatment wereshowed significant decrease ($P \leq 0.01$) from the mean level of lactose and calcium in the milk of unaffected quarter. During treatment, the lactose and calcium levels in milk in clinical mastitis gradually increased on third day which was treated with tri- sodium citrate along with antibiotic (group 1). And on sixth day of treatment the lactose and calcium levels in milk of the above group of animals became normal. This was in agreement with the findings of Dhillonet *al.* (2000). Not much difference observed between the two groups.

Among group 1 animals (treated with antibiotic plus tri-sodium citrate) 100 percentage clinical cure was observed by fifth day of treatment. In 71.4 percentage of cases milk became normal in colour, consistency and without any clots by third day of treatment itself. Where as normal appearance of the milk noted only in 37.5 percentage of cases on third day of treatment, in group 2 (antibiotic alone) animals.

Hundred percent bacteriological cure was observed in group 1 by sixth day of treatment. While only 75 per cent bacteriological cure was observed in the other groups. This was in agreement with Pal *et al.* (1995). Reddy *et al.* (1999) observed only 85 percentage of cure rate in animals treated with tri-sodium citrate orally plus intramammary antibiotic for five days. Failure of citrate therapy in some cases might be due to the presence of heavy bacterial population in mastitic quarter. The citric acid and pH level came to normalcy by sixth day of treatment in group 1 where as adequate normal level was not achieved in group 2. The milk yield was not restored to the expected level in group 1. But in 28.57 percentage of cases level has been reached to the pre infection level.

It can be presumed that oral administration of tri- sodium citrate restored the normal citric acid level in the milk. Citrate was essential for the milk synthesis and it can be regarded as a harbinger for lactogenesis (Peaker and Linzell, 1975).

Table 1. Biochemical changes in milk - Clinical Mastitis – Group 1 (Treated with Antibiotic and trisodium citrate) (Mean \pm SE)

No. of animals	Parameters	Zero th day	Third day	Sixth day	Normal milk from non-affected quarter
7	pH	7.483 \pm 0.12	6.85 \pm 0.23	6.55 \pm 0.12	6.6 \pm 0.15
	Citric acid (mg/dl)	60.167 \pm 7.55	127.167 \pm 14.26	145.5 \pm 5.15	145.0 \pm 21.55
	Lactose (g/dl)	1.3 \pm 0.36	3.083 \pm 0.29	4.25 \pm 0.25	4.36 \pm 0.57
	Chloride (g/dl)	0.275 \pm 0.04	0.159 \pm 0.03	0.116 \pm 0.01	0.1139 \pm 0.006
	Calcium (mg/dl)	74.0 \pm 25.81	115.333 \pm 6.06	119 \pm 7.29	123.0 \pm 7.11

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Table 2. Biochemical changes in milk - Clinical Mastitis – Group 2 (Treated with Antibiotic alone) (Mean±SE)

No. of animals	Parameters	Zero th day	Third day	Sixth day	Normal milk from non-affected quarter
8	PH	7.533 ± 0.38	7.0 ± 0.24	6.683 ± 0.15	6.6 ± 0.15
	Citric acid (mg/dl)	60.183 ± 6.85	92.3 ± 40.34	128.833 ± 16.86	145.0 ± 21.55
	Lactose (g/dl)	1.6 ± 0.53	3.25 ± 0.65	4.233 ± 0.43	4.36 ± 0.57
	Chloride (g/dl)	0.289 ± 0.04	0.181 ± 0.03	0.123 ± 0.01	0.1139 ± 0.006
	Calcium (mg/dl)	71.0 ± 28.95	94.0 ± 16.92	113.333 ± 7.12	123.0 ± 7.11

V. CONCLUSION

Oral administration of tri-sodium citrate along with antibiotic found to be effective in managing clinical mastitis cases. Hundred percentage bacteriological cure was noticed in trisodium citrate along with antibiotic treated group on sixth day whereas only 75 per cent bacteriological cure observed in the other group. One of the factors which influence the pH of the milk is the secretion of the citrate in to the milk (Schalm *et al.*, 1971). So in the present study it can be presumed that oral administration of the tri- sodium citrate along with the parenteral antibiotic therapy increases the concentration of the citric acid in milk which internhelps to restore the normal pH of the milk. The other biochemical characters of the milk came to normal level in all cases in this group by sixth day of treatment. Increase in milk production after the treatment was also found to be slightly better in animals treated with tri-sodium citrate.

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